80 W ONBOARD GENERATOR SYSTEM

USER MANUAL 1.4

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

1. Description

Onboard Generator system consists of a Generator Power Unit (GPU), belt driven industrial-grade coreless generator, mounts and wiring necessary for installation on 3W 28i pusher engine. System was specifically developed to be used with UAV Factory's Penguin B UAV, but can also be used in other applications. GPU is designed to provide onboard dual voltage regulated power supply of 6 and 12 Volts. Despite small size, GPU offers outstanding efficiency as well as unique features such as the ability to monitor load, battery current, engine rpm, generator and battery voltage through serial communication. All power distribution parameters can be transmitted to the UAV ground control station and monitored during the flight.

Integrated Lithium Polymer charger is used for the backup battery, which is switched on during the pre-flight checks, low engine speed or in the event of the engine failure. GPU is packed in a sealed aluminum enclosure and fitted with the high-end industrial push-pull connectors.

Please refer to Figure 1 for a view of installed onboard generator system.

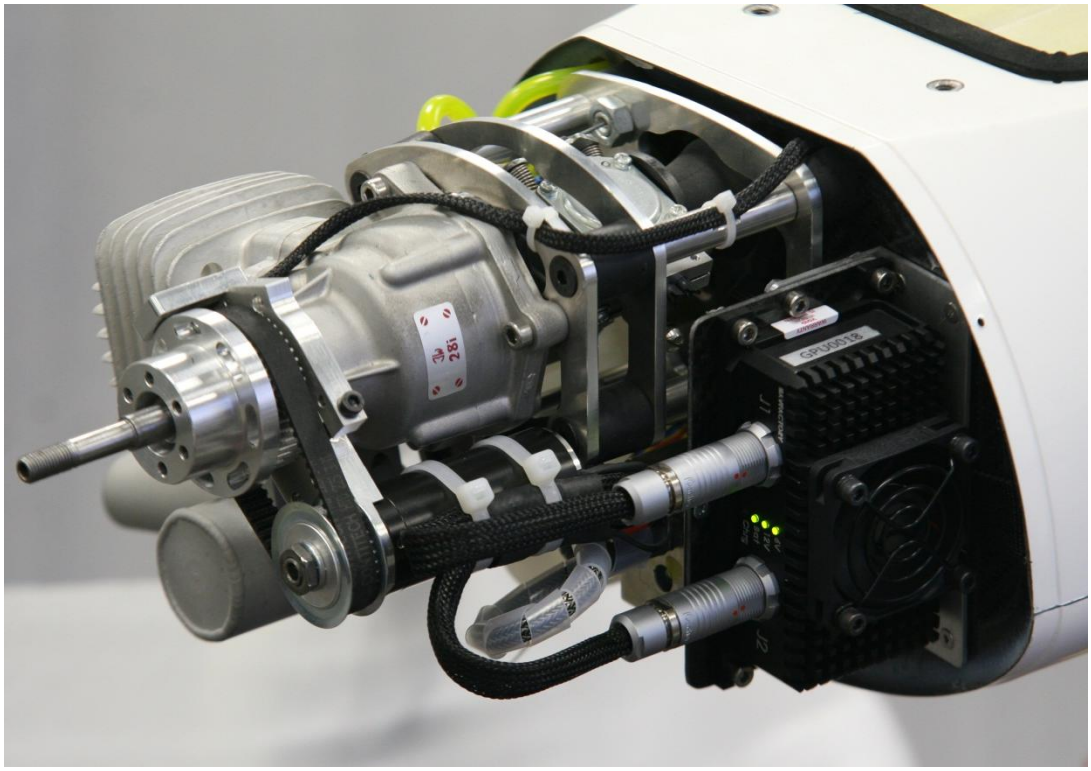

Figure 1 80W onboard generator system installed in Penguin B UAV

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

2. Key Features

- Light weight, small and efficient
- Up to 80 W continuous load power[1]
- 6 V and 12 V output
- Peak load current up to 10 A
- Short circuit protection
- Battery backup connection
- 3 cell Li-Poly integrated charger
- External power connection
- Integrated current sensors
- Serial connection
- IP 64 housing, IP 68 on request

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

3. Specifications

Electrical Specifications	
Generator voltage range	13 – 35 V
External power supply voltage range	13 – 50 V
Battery Type	3 cells, Lithium Polymer
Battery Voltage	12.6 V
Maximum battery charging current	2 A
Maximum continuous generator current	3.5 A
Maximum continuous battery current	8 A
Maximum continuous external power current	8 A
Output voltage	6 V and 12 V
Output voltage accuracy	0.2 V
Maximum output voltage ripple	50 mV@6V 50 mV@12V
Continuous load current, 6 Volt output[1,2]	5A
Continuous load current, 12 Volt output[1,2]	5A
Maximum GPU efficiency	90 %
Maximum complete system efficiency	75 %
Maximum peak load current	10 A for 10 seconds
No load GPU current	110 mA
Tachometer range	1000-9000 rpm
Tachometer accuracy	200 rpm
Current sensor range	0 to 10 A
Current sensor accuracy	0.2 A
Voltage sensor accuracy	0.1 V
Serial Communication	5V TTL
Mechanical Specifications	
Engine speed	1500 – 8500 RPM
GPU Dimensions	59.4 x 115.8 x 32.4 mm
GPU Weight	~190 grams
Complete Onboard Generator System weight	~500 grams
Maximum GPU enclosure temperature	70°C
Environmental protection	IP 64 standard, IP 68 on request
Operating temperature	- 40°C to +50°C [2]
Electrical connectors	Fischer 104 Series push-pull connector

[1] Generator continuous current must not exceed 3.5 A

[2] Enclosure temperature must not exceed 70 °C , additional cooling may be required

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

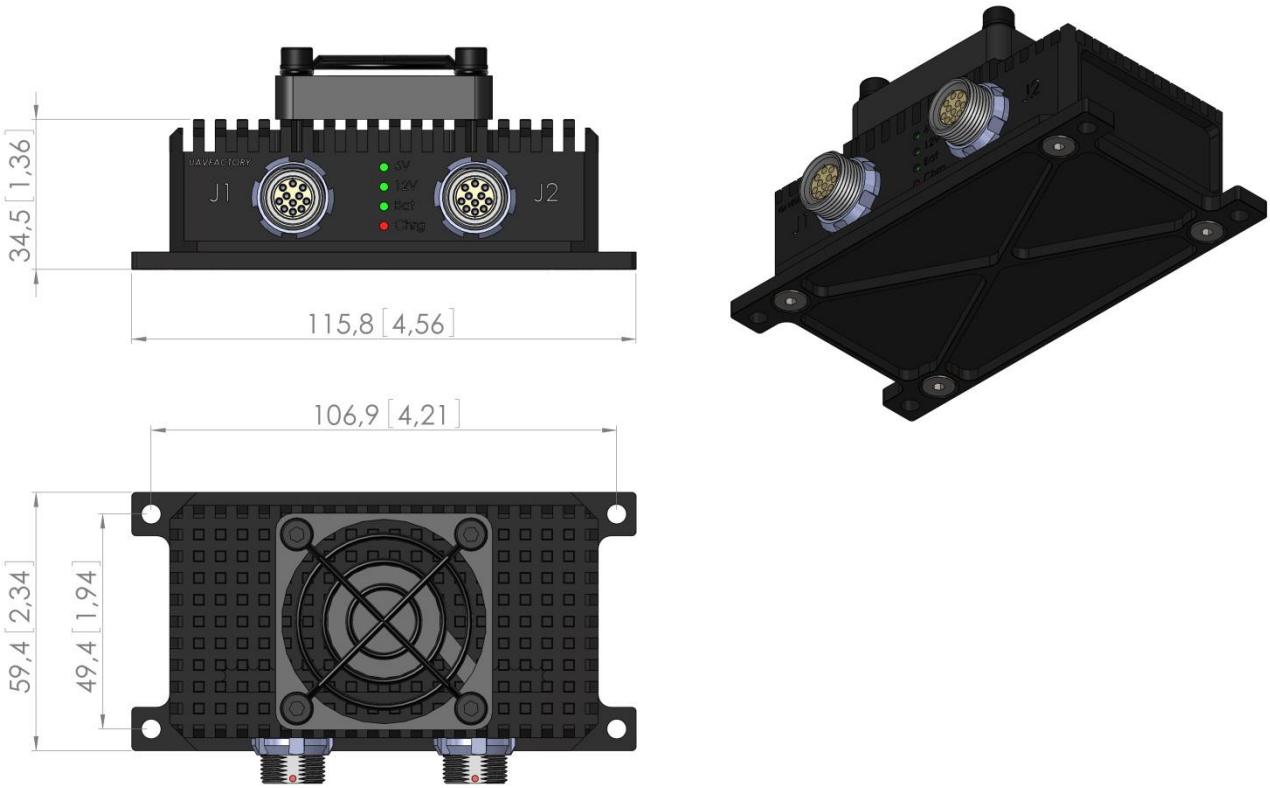

Figure 2 GPU dimensions in millimeters

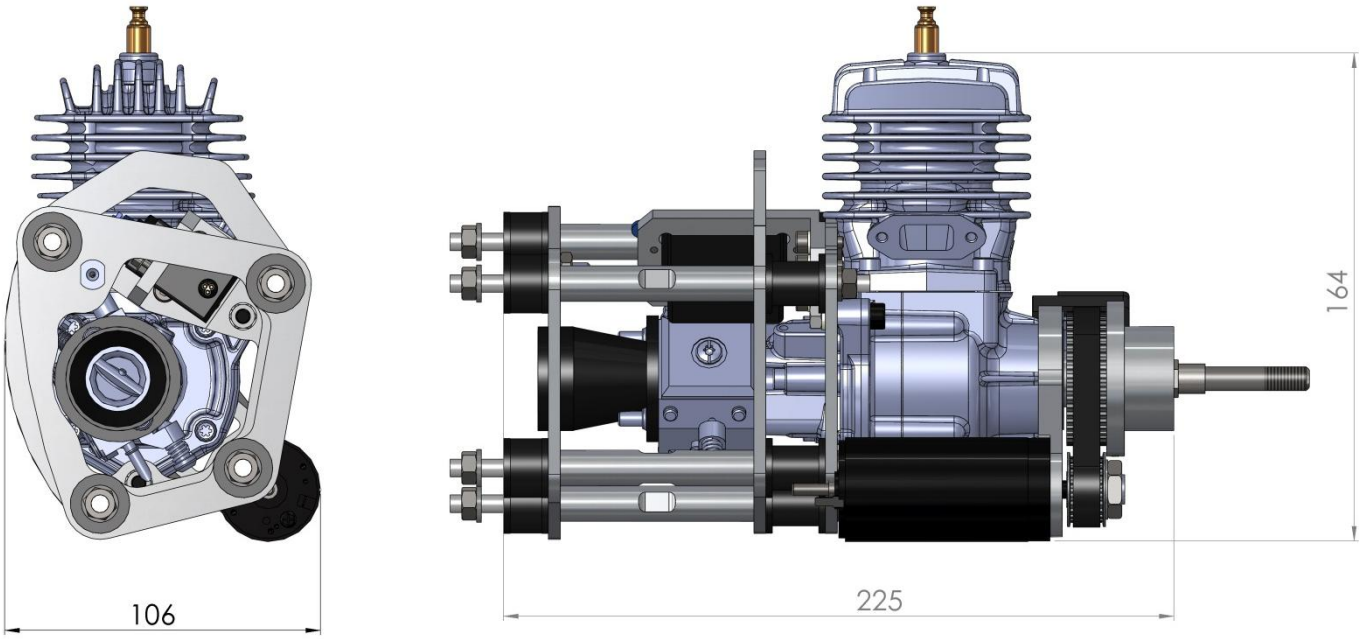

Figure 3 General view of generator assembly

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

4. Performance

The GPU performance graphs are presented below. Efficiency for the 6 V output against the input voltage is shown in Figure 4, efficiency for 12 V output is shown in Figure 5. Generator performance graphs are presented in Figure 6 and Figure 7.

Please refer to Figure 7 for generator operation regime- in case of generator voltage drop below 13 Volts, GPU uses the backup battery for the power source. The continuous generator system operation regime is shown as the blue area; the battery operation regime is shown with the green area. The short term operation area can only be used for a short duration power peaks. The maximum continuous power of the system is dependent on the engine speed, ambient temperature and the ability to dissipate heat generated by the GPU. At no circumstances operating GPU enclosure temperature should reach 70° C.

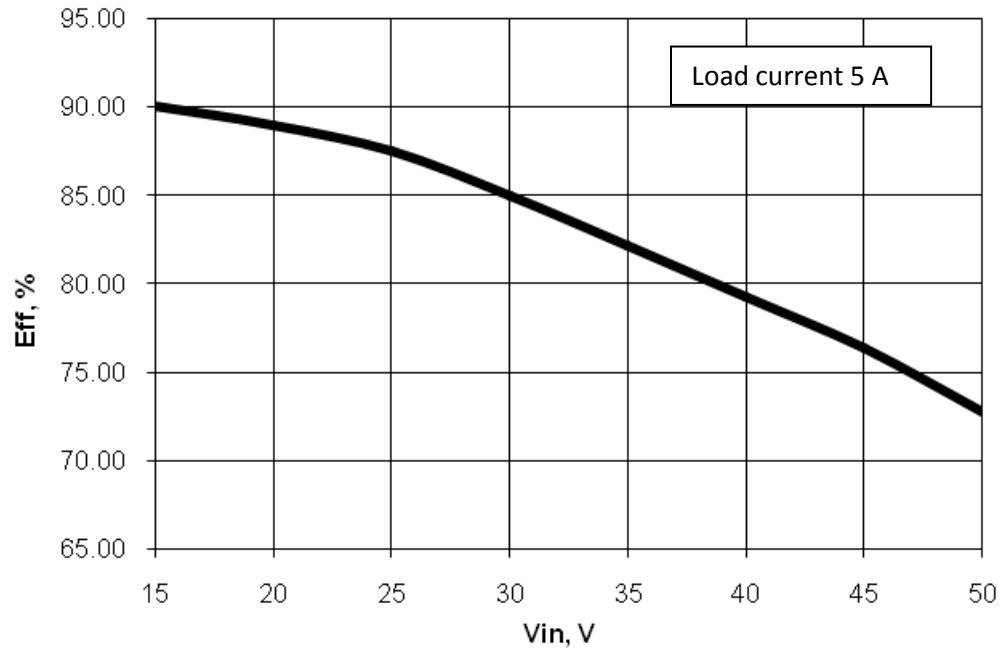

Figure 4 Efficiency at 6 Volt output versus input voltage

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

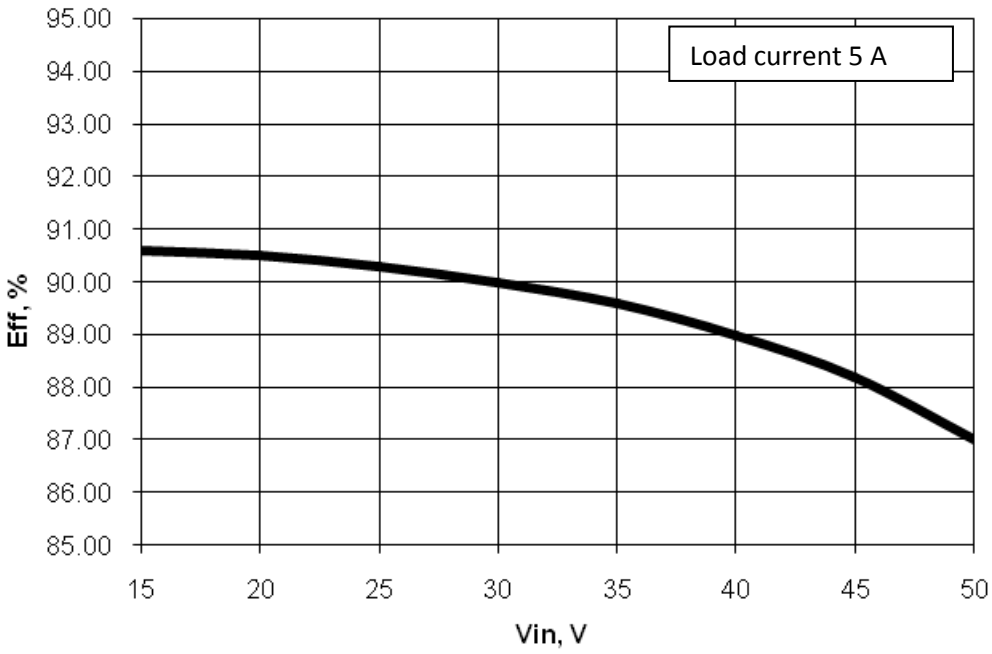

Figure 5Efficiency at 12 Volt output vs input voltage

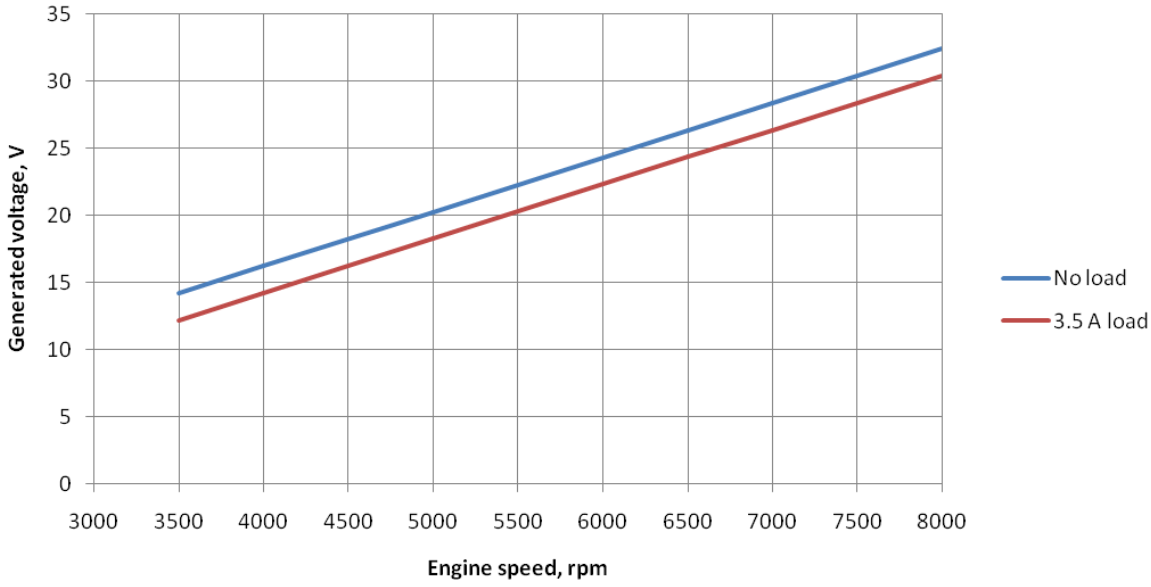

Figure 6 Generated voltage against engine speed, measured at the generator output terminals

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

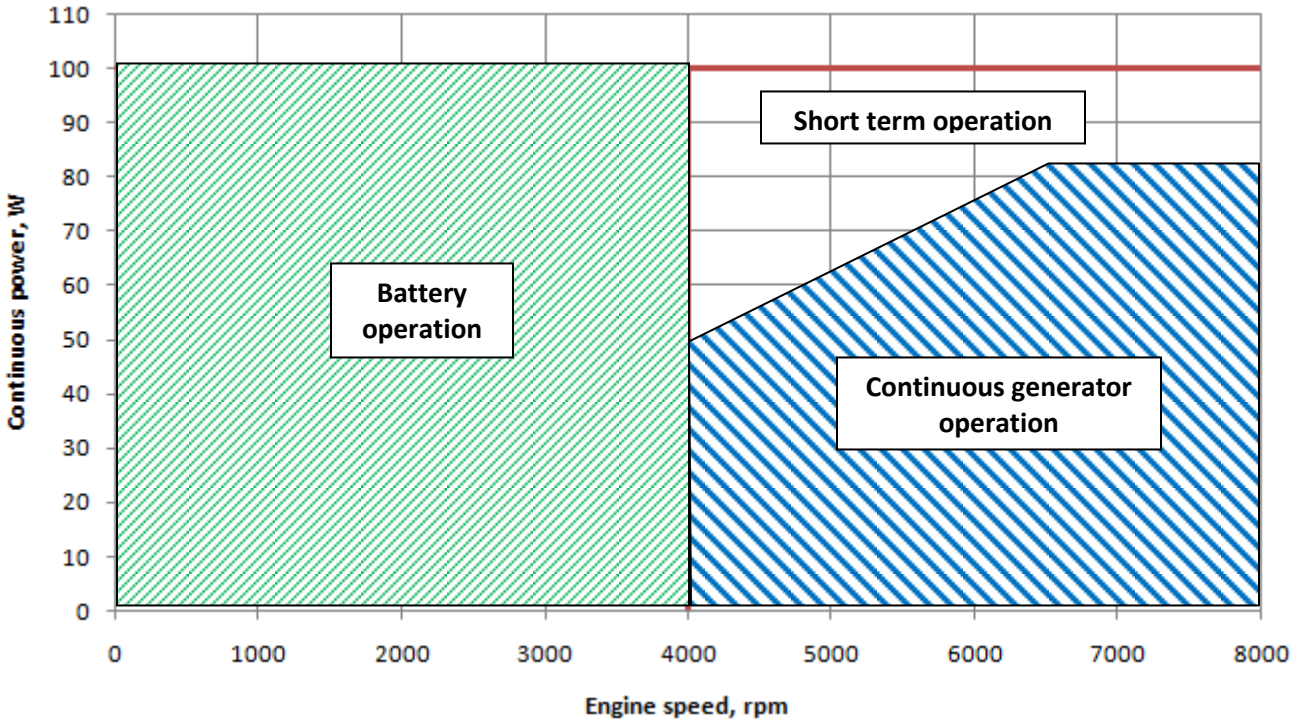

Figure 7 Recommended continuous system load power

5. Onboard generator system operation

At approximately 4000 rpm the voltage generated is less than 13 V, which means that the onboard battery will be used for powering the unmanned aircraft system. This is not a problem, since aircraft do not generally fly at low idle settings for extended periods of time and the power requirements can be met by the adequate-sized onboard battery. The onboard battery capacity needs to be calculated, depending on the actual mission profile of the UAV, taking into account possible aircraft descend time as well as desired pre-flight operation time- please see Section 7 for more details on battery capacity estimation. Please use adequate safety factor for your battery capacity estimation results.

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

6. Short circuit protection

The GPU has integrated short circuit protection for avoiding the regulator damage in case of a short circuit.

In case multiple loads are used on the same voltage line, it is highly recommended to use fuses- this will allow the GPU to operate in the event of load short circuit. Please see Figure 8for a diagram of fuse installation.

As an example, fuses can be installed before the payload, rf-transmitters as well as before the individual servos.

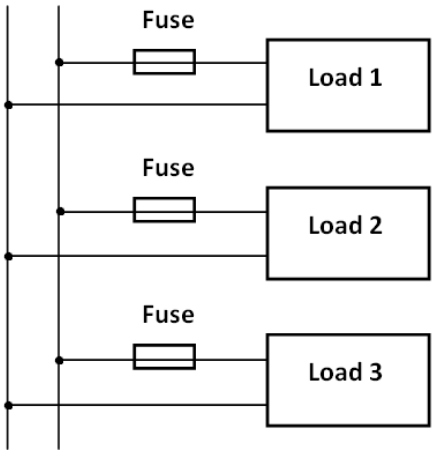

Figure 8 Fuse installation

7. Battery backup

External battery provides power supply to the onboard system in case the input voltage drops below the battery voltage. This may occur because of several reasons:

a) During engine idle, when generator provides insufficient voltage at the given load

b) During pre-flight preparation, when the engine is not operating and the external power supply is not connected

c) During mechanical generator failure

d) During engine failure

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

Integrators should use the following formula to calculate approximate battery capacity for their UAV configuration:

Battery capacity (Ah) = operation time (h) × average load power (W) / battery voltage (V) / 0.8

Where operation time is desired operation time, battery voltage typically is 11.1 V and 0.8 is regulator typical efficiency.

Do not use other type of battery except Lithium Polymer, 3 cell batteries. Maximum battery current should not exceed 8A. When battery voltage is less than 12.6 V the charger charges the battery with current of <= 2 A. It is recommended to connect battery to the system through a switch with current rating not less than 10 A.

When the battery source is used, GPU is not producing exactly 12 volt power output, please see Figure 9 for details. The battery voltage and output voltage difference is approximately 0.4V. Please note that GPU cannot provide 12 V voltage if battery voltage is less than 12.4 V.

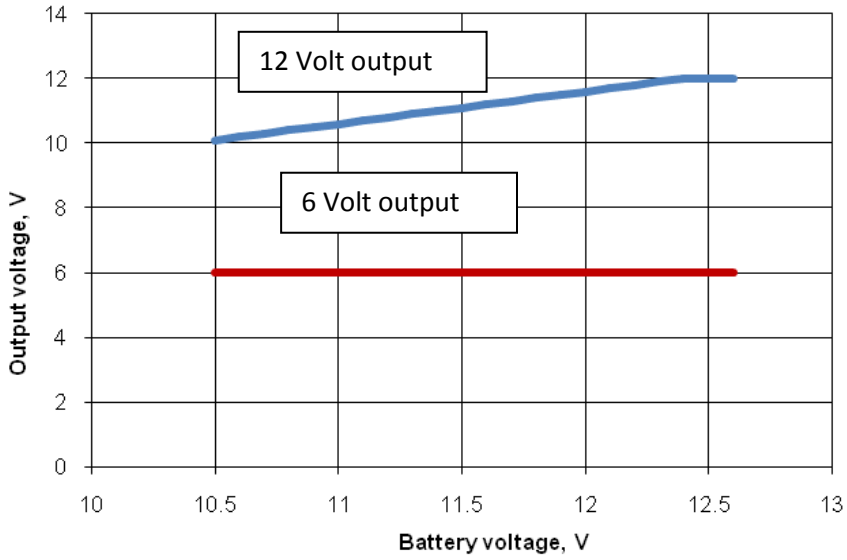

Figure 9 Output voltage in battery source mode

8. External Power Supply

External power supply can be used as a power source when the engine is no operating. This is especially useful for laboratory environment testing, during set-ups, during pre-flight checks on field as well as for charging the onboard battery. The input voltage should be in the range of 13-50 Volts.

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

9. Connector Description

GPU enclosure has two electrical connectors - J1 and J2, as seen on Figure 10. Pinout of J1 connector is shown in Figure 11 and pinout for J2 is shown in Figure 12.

The layout of the onboard generator system is shown in Figure 13; please use Table 1 for wiring description during integration procedure.

Figure 10 Input, Output connectors and status LEDs

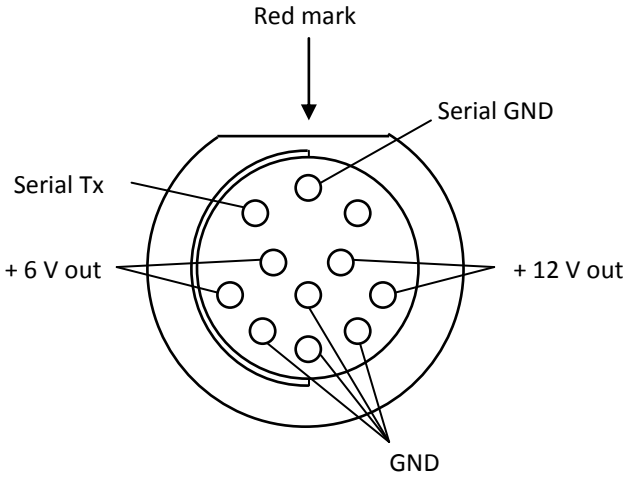

Figure 11 Connector J1 description

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

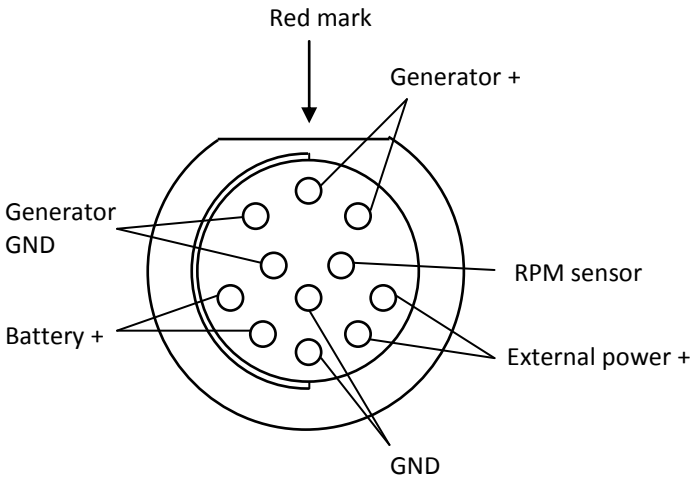

Figure 12 Connector J2 description

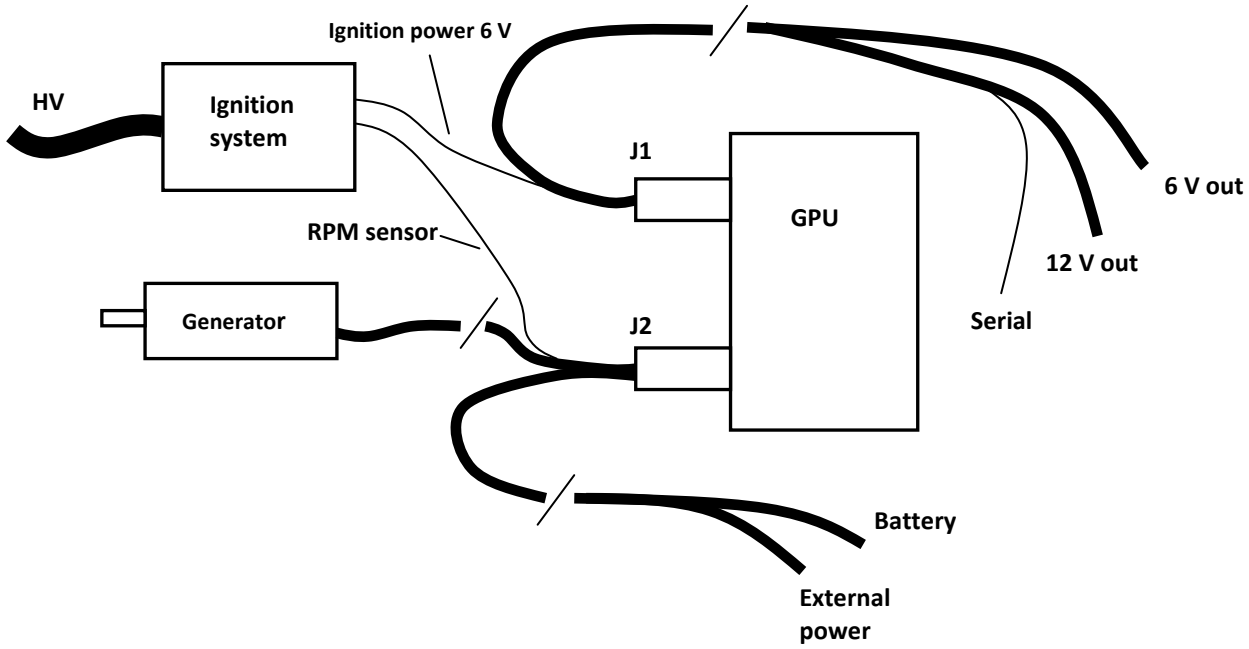

Figure 13 Onboard generator system wiring diagram

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

Table 1 Wiring description

Label	Wire color	Connection description
GEN	red	Brushless generator phase A
	red	Brushless generator phase B
	red	Brushless generator phase C
GEN	red	Brushed generator "+" lead
	black	Brushed generator "–" lead
Ignition	red	Power output for ignition module (6V)
	black	Power ground for ignition module (GND)
RPM input	yellow	RPM sensor input (Signal)
	black	RPM sensor ground (GND)
Serial	green	Serial interface output (Tx)
	black	Serial interface ground (GND)
BATT	red	Battery power input (3 Cell LiPo)
	black	Battery power ground (GND)
EXT	red	External power supply input (13-50V)
	black	External power ground GND)
6Vout	red	6V power output (6.0V)
	black	6V power ground (GND)
12Vout	red	12V power output (12.0V)
	black	12V power ground (GND)

10. LED Indication

Four indication LEDs are located on the front side of the GPU, see Figure 10 for reference. The main purpose of LEDs is to facilitate set-up procedure, simplify pre-flight checks as well as to provide clear identification of the battery status before the flight. The following LED operation is implemented in the GPU:

6 V – green LED indicates 6 V voltage presence.

12 V – green LED indicates 12 V voltage presence.

BAT – green LED indicates that battery is supplying the system. When LED is off the generator or external power is supplying the system.

CHRG – red LED indicates battery charging. When LED is flashing the battery voltage is low and needs recharging- please connect external power supply for recharging the battery.

11. Serial communication (Firmware V1.1)

Serial communication allows monitoring system variables such as: generator and battery voltage, battery and load currents, total system power and RPM value.

Serial protocol uses 84 bytes packet and send it two times per second. Figure 14 shows the output string format. Variables are separated with 3 spaces. The output string example is:

Rpm=3400 Vgen=27.3 Vbatt=11.82 Ibatt=-1.3 I6v=1.2 I12v=0.8 Pout=16.8 \r\n

Rpm – rpm value

Vgen – generated voltage

Vbatt – battery voltage

Ibatt – battery current (negative value for charging)

I6v – load current at 6 V line

I12v – load current at 12 V line

Pout – total output power

Serial communication settings:

Baud rate 9600

Bits 8

No parity

Important: GPU serial connection uses 5V TTL communication.

B00	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16
R	p	m	=					space	space	space	V	g	e	n	=	

B17	B18	B19	B20	B21	B22	B23	B24	B25	B26	B27	B28	B29	B30	B31	B32	B33
			space	space	space	V	b	a	t	t	=					

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

B34	B35	B36	B37	B38	B39	B40	B41	B42	B43	B44	B45	B46	B47	B48	B49	B50
space	space	space	l	b	a	t	t	=						space	space	space

B51	B52	B53	B54	B55	B56	B57	B58	B59	B60	B61	B62	B63	B64	B65	B66	B67
l	6	v	=				space	space	space	l	1	2	v	=		

B68	B69	B70	B71	B72	B73	B74	B75	B76	B77	B78	B79	B80	B81	B82	B83
	space	space	space	P	o	u	t	=						\r	\n

Figure 14 Output string format

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com

12. Order Information

GS80U – Penguin B generator upgrade kit (battery is not included)

GPU Accessories		
Item	**Order code**	**Qty**
FISCHER cable plug for J1	S104A056	1
FISCHER cable plug for J2	S104Z056	1
Cable set with plug for J1, 50 cm	SJ105	1
Cable set with plug for J2, 50 cm	SJ205	1
Cable set with plug for J1, 100 cm	SJ110	1
Cable set with plug for J2, 100 cm	SJ210	1

History:

Manual Version	**Description**	**Date**	**Edited by**
1.0	User Manual V1.0 created		A.Guks
1.1	Serial Communication updated to Firmware 1.1, all generator systems with S/N GPU0008 and up have Firmware 1.1	29.07.2011	A.Guks
1.2	Table 1 and Figure 14 revision	7.11.2011	A.Guks
1.3	Company information updated. Images updated.	13.12.2011	K.Popiks

UAV Factory USA LLC.
50 South Buckhout Street,
Irvington, NY 10533 USA
Phone: +1 (914) 591 3070
Fax: +1 (914) 591 3715
Email: josephm@uavfactory.com

UAV Factory LTD. EUROPE
24A-52 Ganibu Dambis,
LV1005, Latvia
Phone: +371 29119398
Fax: +371 63048747
Email: sales@uavfactory.com